

Alcatel-Lucent 7750 SR

SERVICE ROUTER

With 1 terabit of throughput, the Alcatel-Lucent 7750 Service Router is a superior multiservice router that gives service providers, multiple service operators (MSOs), mobile operators and enterprises a competitive advantage with industry-leading throughput, performance, density and service depth.



Alcatel-Lucent is at the forefront of the development and delivery of ultra-scalable IP/MPLS networks. With a vision, portfolio and commitment to solve the networking challenges driven by the increased use of video and multimedia applications and the convergence of residential, business and mobile networks, Alcatel-Lucent has raised the bar. Industry-leading technology innovation and execution has transformed the Alcatel-Lucent 7750 Service Router (SR) into a 1 terabit service router platform with high touch services as well as full investment preservation. This architecture will support future scaling to 2 terabytes.

Designed from inception to enable triple play, premium virtual private network (VPN) and multimedia mobile services and converge these services over the IP/MPLS network, the Alcatel-Lucent 7750 SR is a highly programmable, high-performance multiservice router with industry-leading resiliency and scalability. With outstanding throughput, performance, density and service depth, the 7750 SR is targeted at service providers, MSOs, mobile operators and enterprise customers with IP/MPLS requirements.

In addition to Layer 3 services, the 7750 SR is MEF 9- and MEF 14-certified and is the platform of choice for service providers and MSOs who want to deploy robust and highly reliable MEF-certified networks.

Unlike legacy Internet era routers with expensive, highly disruptive and unproven migration strategies for next-generation service delivery, the Alcatel-Lucent 7750 SR delivers high-performance routing, highly available services, simultaneous support for Layer 2 and Layer 3 services, the virtualization of advanced services and investment preservation that leverages all in-place hardware for incremental performance gains and service expansion. As a result, the 7750 SR is production-proven and has become the routing platform of choice for large-scale IP network transformation projects the world over.

Purpose-built architecture

At the heart of the Alcatel-Lucent 7750 SR is the fully programmable, highly flexible FP packet processing silicon technology. Based on state-of-the-art Network Processing technology, the Alcatel-Lucent FP processing complex provides industry-leading performance, service depth and feature velocity. A revolutionary breakthrough in silicon technology, Alcatel-Lucent's new FP2 packet processing technology now delivers up to 100 Gb/s throughput and delivers an optimal combination of performance and service flexibility to support hardware-based IP/MPLS, IPv4 and IPv6 routing, granular traffic management and high-touch packet services in a single routing complex. FP technology delivers a high degree of scalability with performance predictability and can sustain line-rate forwarding with all services enabled. FP technology delivers rich and robust multiservice routing capabilities, supporting the full complement of routing and switching protocols, and delivers highly scalable multicast services.

Each FP Processing Complex is composed of customized, fully programmable processors. These are optimized for fast packet manipulation, allowing the Alcatel-Lucent 7750 SR to deliver the speed, density and packet processing intelligence required to enable high-performance IP/MPLS/Ethernet services with legacy service migration support over the IP/MPLS network infrastructure. In addition, FP technology supports all interface types, so common silicon is used across platform interface modules, enabling absolute service consistency with complete interoperability. Purpose-built and optimized for high-demand environments, FP technology enables the 7750 SR to deliver a variety of complex consumer, business and mobile services with granular per-service and/or per-subscriber controls.

High-performance service routing

The Alcatel-Lucent 7750 SR is a scalable routing platform that delivers high-touch packet processing to enable next-generation service creation without compromising forwarding performance, service depth and throughput. The market-leading innovation of packet processing complex gives the 7750 SR wire-speed packet tunnel encapsulation, forwarding tables that scale to 3 million IPv4 and IPv6 addresses, 64,000 queues per Input/Output Module 3-XP (IOM3-XP), enabling up to eight queues per subscriber, with no packet loss. The 7750 SR supports standards-based implementations of the full range of unicast and multicast routing protocols: Border Gateway Protocol (BGP-4), Intermediate System to-Intermediate System (IS-IS), Open Shortest Path First (OSPF) v3, Internet Group Management Protocol (IGMP) v3 and Protocol Independent Multicast — Sparse Mode (PIM-SM). The 7750 SR uses the Alcatel-Lucent Service Router Operating System (SR OS) image, across all platforms, for operational simplicity and to provide a highly scalable software foundation that is tightly integrated with the FP technology architecture.

Multigenerational interoperability

Multigenerational interoperability between IOMs, Media Dependent Adapters (MDAs) and Integrated Service Adapters (ISAs) allows service providers, MSOs, mobile operators and enterprise customers to leverage all in-place hardware, enabling them to achieve incremental performance and service gains with no compromise on performance. Networks using current generation FP technology are fully and seamlessly upgradable to FP2, thereby fully preserving carriers' current investments and extending them well into the future. In addition, to simplify sparing requirements, IOMs, MDAs, ISAs, Switch Fabric/Control Processor Modules (SF/CPMs), power supplies and fans are portable between the platforms.

MPLS

Multiprotocol Label System (MPLS) is field proven, follows a highly consolidated standardization process and is the key enabling technology for IP network and service transformation — for the core and edge network segments. Consistent with the attributes of MPLS, the Alcatel-Lucent 7750 SR enables the full range of control plane scalability, Layer 2 and Layer 3 protocols such as Ethernet, Frame Relay, ATM, BGP-4, IS-IS and PIM-SM to make it the platform of choice to enable network convergence. The 7750 SR supports the full range of the IETF's architecture, stack, traffic engineering, signaling, Pseudowire Emulation Edge-to-edge (PWE3) and OAM standards for service tunneling flexibility. The 7750 SR is capable of delivering any combination of services to any port, without compromising service depth and performance.

Flexible service deployment

The Alcatel-Lucent 7750 SR leverages the sophisticated FP technology to deliver the service awareness and performance with the service depth that higher-margin services require. The 7750 SR has a highly scalable service-aware architecture capable of providing simultaneous support for triple play, mobile, Virtual Private LAN Services (VPLS), Virtual Private Wire Services (VPWS), enhanced Internet services and IP virtual private network (VPN) services. It has the field-proven performance to scale BGP peers, routing and forwarding tables, Layer 2 and Layer 3 service instances, pseudowire terminations and service queues to concurrently support the most demanding consumer, business and mobile services. The robustness of the 7750 SR to converge multiple services over one IP/MPLS network has been validated in independent tests by Isocore, an industry-recognized third-party test organization.

Service-aware QoS provides service-based queuing, policing and shaping, with per-service bandwidth guarantees,

to meet the most demanding SLAs. For increased service differentiation, the 7750 SR delivers service-aware Hierarchical Quality of Service (H-QoS) and accounting for innovative service bundles. This helps guarantee the performance of each forwarding class in terms of bandwidth, delay and jitter, while allowing lower priority traffic to burst when higher priority applications go idle. To ensure service continuity with legacy services, the 7750 SR supports network and service interworking between Ethernet, Frame Relay and ATM.

Service integration and virtualization

The Alcatel-Lucent 7750 SR further increases service depth by integrating advanced services into the platform using an ISA. With intelligent Layer 3 to Layer 7 service capabilities, the 7750 SR unifies advanced services integration with high-touch services and ushers in a new realm of convergence.

ISAs, half-slot MDA form factor adapter, extend the level of intelligence of the industry-leading Service Router platform by virtualizing advanced service capabilities into a single, unified IP/MPLS and/or Carrier Ethernet service edge. These adapters provide purpose-built, extended functionality to the 7750 SR, enabling deeper levels of service capabilities typically available from external dedicated, network-attached appliances.

The Application Assurance Integrated Service Adapter (AA-ISA) significantly extends the service depth and functionality of the 7750 SR by virtualizing advanced application intelligence, with extensive subscriber policy and traffic management capabilities. The AA-ISA enables service providers, MSOs, mobile operators and enterprise customers to deliver enhanced and personalized, QoS-managed application performance that significantly improves service levels and extends assurance of application performance.

The IPsec Integrated Service Adapter (IPsec-ISA) simplifies the creation and enforcement of highly scalable line-rate secure IP VPN for multi-enterprise, multi-user deployments to concurrently support a mix of VPN services.

Migration to IPv6

The Alcatel-Lucent 7750 SR is equipped with a dual IPv4/IPv6 stack, allowing simultaneous delivery of IPv4- and IPv6-based services with no performance impact. This allows the operator to deliver IPv6-based services on a per-customer basis, negating the need to migrate the entire network to IPv6. IPv6 support includes IPv6 provider edge routing, full multicast support and non-stop routing on OSPF, IS-IS and BGP4, enabling a number of applications including, IPv6 Internet exchange peering and IPv6-based Internet services. The comprehensive dual-stack feature set is suitable for all major application deployment types, which include IPv4/v6 triple play, IPv4/v6 business VPN services and IPv4/v6 wireless broadband access/backhaul, beyond switched and routed services network boundaries.

Enabling IPTV and broadband video

The Alcatel-Lucent 7750 SR plays a critical role in triple play service delivery. Service-aware H-QoS provides queuing on a per-service, per-subscriber basis with 8,000 ingress and 8,000 egress queues per slot. Enhanced subscriber management supports a universal approach to managing subscriber identities, profiles and SLAs across a range of deployment models, and enables dynamic autoprovisioning of subscriber and service policies, supporting both RADIUS and Dynamic Host Configuration Protocol (DHCP)-based approaches. The versatility of the 7750 SR supports any mode of operation, allowing the implementation of Layer 2- or Layer 3-based deployment models such as DHCP and Point-to-Point Protocol over Ethernet (PPPoE), along with flexible migration from legacy broadband remote access servers.

WAN optimization

For operators looking to avoid the trap of commoditized business VPN services, the Alcatel-Lucent 7750 SR enables the creation of value-added services with a number of WAN optimization mechanisms. Service-based QoS and the OAM toolkit, multicast replication techniques that minimize bandwidth along with resiliency and availability features serve as the foundation for higher-margin VPN services. The 7750 SR also provides comprehensive security that includes granular traffic inspection, advanced traffic classification and management techniques, as well as control processor module (CPM) queuing to mitigate against denial of service (DoS) attacks and malicious users. Together, these features increase the service depth, allowing the creation of compelling managed network services designed to offload network complexity and deliver cost savings through outsourced services.

Leadership in mobile IP network transformation

The Alcatel-Lucent 7750 SR is also fully equipped to enable mobile network transformation and convergence. By integrating TDM, ATM and Ethernet traffic, the 7750 SR simplifies and scales CDMA/EVDO and GSM/UMTS networks, enabling evolution to an efficient all-IP transport network and removing barriers to offering new services. To handle bandwidth-intensive IP data services, Multilink Point-to-Point Protocol (MLPPP) and ATM Inverse Multiplexing over ATM (IMA) are supported. Circuit Emulation Service (CES) standards, either CES over Packet (CESoP) or Structure-Agnostic Transport over Packet (SAToP), enable the backhauling of 2G and 3G network traffic over IP/MPLS or Ethernet. The 7750 SR adds traffic QoS optimization and control for multilink groups. Using multiclass MLPPP enables efficient multiclass traffic convergence and extends the life of costly backhaul links.

Service reliability

The Alcatel-Lucent 7750 SR was purpose-built from inception to guarantee the highest levels of availability, resiliency and redundancy from hardware and software architectures. The 7750 SR is a fully redundant platform with hot-swappable components, including interface modules, power supplies, and Switch Fabric/Control Processor Module (SF/CPM), with no single point of failure. In addition to hitless in-service software upgrades, Graceful Restart - Helper Mode, Fast Reroute and multichassis automatic protection switching (APS) on SONET/SDH links, the 7750 SR established an industry benchmark with non-stop routing, non-stop services and multichassis Link Aggregation Group (LAG). The industry-leading high-availability features of the 7750 SR have been validated by BT Exact, an industry-recognized third-party test organization. As a result, the 7750 SR maximizes the quality of the user experience with uninterrupted subscriber sessions, fully enforceable stringent SLAs and lifeline services delivery.

Interface options

With highly flexible, modular physical network interface options, the Alcatel-Lucent 7750 SR provides a full breadth of interface types with leading density. MDAs are hot-swappable, half-slot adapters that insert into a full-slot 7750 SR IOM. Supporting up to two MDAs, the IOM provides fully distributed forwarding and packet services and delivers the full complement of the Alcatel-Lucent SR OS capabilities for the 7750 SR. The 7750 SR MDAs deliver comprehensive IEEE 802.3 compliance, and in conjunction with the selected IOM, provide support for Layer 2 and Layer 3 IPv4 and IPv6 routing services, IP/MPLS, Ethernet over MPLS (EoMPLS), VPLS and VPWS with a highly personalized service

context. When used with IOM3-XP, MDA-XP variants provide 25 Gb/s (full duplex) and boost slot capacity to 50 Gb/s (full duplex). As well, MDAs use small form factor pluggable (SFP) optics to provide greater flexibility by populating MDAs with the required optics on a per-port basis.

Service-aware OAM

With a purpose-built service-aware framework, the Alcatel-Lucent 7750 SR offers unprecedented simplification and cost reduction of network operations through rapid diagnosis of network and service level faults, early detection of component and service degradation and a highly automated process of isolating network-induced errors. The 7750 SR service-aware OAM tools include service assurance agent (SAA) tests with scheduling and hardware timestamps, Bidirectional Forwarding Detection (BFD), service ping, LSP ping and traceroute, VPLS ping and traceroute, service mirroring, virtual circuit connectivity verification, IEEE 802.1ah and multicast troubleshooting tools. These tools are integrated into the Alcatel-Lucent 5620 Service Aware Manager (SAM), which uses a GUI to ensure rapid fault isolation.

Streamlining network management

The Alcatel-Lucent 7750 SR is fully managed by the industry-leading Alcatel-Lucent 5620 SAM and Alcatel-Lucent 5650 Control Plane Assurance Manager (CPAM). The 5620 SAM is a single management platform offering the unification of element, network and service management. It gives the

operator a comprehensive fault management system with which to perform root cause analysis, schedule a suite of OAM tests for SLA compliance, run predefined test suites, set threshold crossing alerts to detect potential SLA violations and simplify service provisioning with GUI-based templates. The 5650 CPAM is an IP/MPLS multivendor-compatible control plane management solution. It enables service operators to assure network and service availability against control plane misconfigurations, malfunctions and undetected routing updates as well as to accelerate service problems resolution over an IP/MPLS infrastructure. Together, the Alcatel-Lucent 7750 SR, the 5620 SAM and 5650 CPAM form the industry's most comprehensive unified IP network resource and service management solution.

Chassis options

The Alcatel-Lucent 7750 SR portfolio enables cost-optimized next-generation infrastructure build-outs with three chassis options for a right-sized solution — SR-12, SR-7 and SR-1 — all of which offer leading throughput and density, the ability to mix and match a wide range of interface types and portability of modules across the platforms. The 12-slot SR-12 chassis provides 1 terabit of throughput, the seven-slot SR-7 delivers 500 Gb/s of throughput and the single-slot SR-1 delivers 40 Gb/s of throughput.

Technical specifications



7750 SR-12

System throughput

- Switch fabric: Up to 1 Tb (half duplex)
- Slot capacity: Up to 50 Gb/s (full duplex)

IOMs supported

- IOM-2
- IOM3-XP

Number of IOMs supported per chassis

- 10 - Any mix of IOM-2 or IOM3-XP

Number of half-slot of MDAs per chassis

- 20 - Any mix of MDA or MDA-XP

Redundancy

- SF/CPM, power, fans

Hot-swappable modules

- SF/CPM, power, fans, IOM, MDA, ISA

Dimensions

- Height: 62.2 cm (24.5 in.)
- Width: 44.4 cm (17.5 in.)
- Depth: without cable: 64.5 cm (25.4 in.); with cable: 76.5 cm (30.1 in.)

Weight

- Empty: 33.1 kg (73 lb)
- Loaded: 136 kg (300 lb) approx.

Power

- -40 V DC to -72 V DC (nominal)
- 175 A to 98 A
- 1+1 redundancy

Cooling

- Front-to-back air flow



7750 SR-7

System throughput

- Switch fabric: Up to 500 Gb/s (half duplex)
- Slot capacity: Up to 50 Gb/s (full duplex)

IOMs supported

- IOM-2
- IOM3-XP

Number of IOMs supported per chassis

- 5 - Any mix of IOM-2 or IOM3-XP

Number of half-slot of MDAs per chassis

- 10 - Any mix of MDA or MDA-XP

Redundancy

- SF/CPM, power, fans

Hot-swappable modules

- SF/CPM, power, fans, IOM, MDA, ISA

Dimensions

- Height: 35.5 cm (14.0 in.)
- Width: 44.4 cm (17.5 in.)
- Depth: 59.7 cm (23.5 in.)

Weight

- Empty: 27.2 kg (60 lb)
- Loaded: 70.3 kg (155 lb) approx.

Power

- -40 V DC to -72 V DC (nominal)
- 100 A to 56 A
- 1+1 redundancy

Cooling

- Side-to-back air flow



7750 SR-1

System throughput

- Switch fabric: Up to 40 Gb/s (half duplex)
- MDA half-slot capacity: Up to 10 Gb/s (full duplex)

IOMs supported

- Integrated IOM and SF/CPM

Number of IOMs supported per chassis

- Not applicable

Number of half-slot of MDAs per chassis

- 2 - Any mix of MDA or MDA-XP

Redundancy

- Power

Hot-swappable modules

- Power, integrated IOM and SF/CPM, MDA

Dimensions

- Height: 6.6 cm (2.6 in.)
- Width: 44.4 cm (17.5 in.)
- Depth: 56.4 cm (22.2 in.)

Weight

- Empty: 59.4 kg (27 lb)
- Loaded: 12.25 kg (27 lb) approx.

Power

- 110 V AC or 220 V AC
- -40 V DC to -72 V C (nominal)
- 10 A to 6 A
- 1+1 redundancy
- AC available with external shelf

Cooling

- Side-to-side air flow

Physical interface

- SF/CPM
 - 7750 SR-12 – 1 Tb/s (half duplex)
 - 7750 SR-7 – 500 Gb/s (half duplex)

- Input/Output Modules
 - IOM3-XP* – 50 Gb/s (full duplex)
 - IOM-2 – 20 Gb/s (full duplex)

* Note: Requires SR OS Release 6.1 (Target availability Q3 2008)

- Integrated IOM and SF/CPM (7750 SR-1 only)
 - With integrated switch fabric and CPU (1 GB)

Table 1. 7750 SR MDA and MDA-XP summary and chassis port density

MDA TYPE	PORT COUNT	INTERFACE TYPE	SR-1	SR-7	SR-12
ETHERNET MDA-XP*s					
1000Base	20	SFP	40	200	400
10/100/1000Base	20	RJ-45	40	200	400
10GBase	2	XFP	4	20	40
10GBase	4	XFP	8	40	80
ETHERNET MDAs					
10/100/1000Base-TX	20	RJ-45	40	200	400
100Base-FX	20	SFP	40	200	400
10/100Base-TX	60	5 x mini RJ-21	120	600	1200
1000Base (5-port)	5	SFP	10	50	100
1000Base (10-port)	10	SFP	20	100	200
1000Base (20-port)	20	SFP	40	200	400
10GBase/1000Base	1/10	SFP/XFP	2/20	10/100	20/200
10GBase (LAN/WAN PHY)	1	Simplex SC	2	10	20
10GBase (LAN PHY)	1	XFP	2	10	20
10GBase (LAN PHY)	2	XFP	4	20	40
PoS MDAs					
OC-3c/STM-1c	8	SFP	16	80	160
OC-3c/STM-1c	16	SFP	32	160	320
OC-3c/STM-1c/OC-12c/STM-4c (Multirate)	8	SFP	16	80	160
OC-3c/STM-1c/OC-12c/STM-4c (Multirate)	16	SFP	32	160	320
OC-48c/STM-16c	2	SFP	4	20	40
OC-48c/STM-16c	4	SFP	8	40	80
OC-192c/STM-64c with SR-1/I-64.1 Optic	1	Simplex SC	2	10	20
OC-192c/STM-64c with IR-2/S-64.2 Optic	1	Simplex SC	2	10	20
OC-192c/STM-64c with LR-2/L-64.2 Optic	1	Simplex SC	2	10	20
ANY SERVICE ANY PORT MDAs					
Chan. DS3/E3 Any Service Any Port (ASAP)	4	Mini SMB	N/A	40	80
Chan. DS3/E3 ASAP	12	Mini SMB	N/A	120	240
Chan. OC-3/STM-1 ASAP	4	SFP	N/A	40	80
Chan. OC-12/STM-4 ASAP	1	SFP	N/A	10	20
CIRCUIT EMULATION SERVICE MDAs					
Chan. OC-3/STM-1 Circuit Emulation Services (CES)	1	SFP	N/A	10	20
ATM MDAs					
ATM OC-3c/STM-1c/OC-12c/STM-4c (Multirate)	4	SFP	8	40	80
ATM OC-3c/STM-1c	16	SFP	32	160	320
Versatile Service Adapter	N/A	N/A	2	10	20

* Note: Requires SR OS Release 6.1 (Target availability Q3 2008)

Table 2. 7750 SR ISA summary

ISA TYPE	QUANTITY
Application Assurance Integrated Service Adapter (AA-ISA)^	1 + 1 for redundancy
IPSec Integrated Service Adapter (IPSec-ISA)*^	4 + 1 for redundancy

* Note: Requires SR OS Release 6.1 (Target availability Q3 2008)

^ Note: Requires IOM-2 or IOM3-XP

Software support

Services

- IP VPN (RFC 4364)
- VPWS point-to-point Layer 2 VPN
- VPLS multipoint Layer 2 VPN (RFC 4762)
- Direct Internet access
- CES
- Mobile transport
- IP multicast support with Virtual Private Routed Network (VPRN) using "draft Rosen"
- PWE3 using "draft Martini" encapsulation
- Generic routing encapsulation (GRE)

QoS

- Per-service QoS with per-service queuing, shaping and policing
- Hierarchical queuing and scheduling
- Ingress and egress buffering (up to 200 ms at 25 Gb/s in each direction)
- Committed information rate (CIR), peak information rate (PIR), maximum burst size (MBS) queue parameters
- Thousands of ingress and egress operations
- Programmable queues with CIR/PIR enforcement
- Premium, assured and best-effort forwarding classes
- IEEE 802.1p filtering/marking/re-marking
- IETF differentiated services code point (DSCP) filtering/marking/re-marking
- Weighted random early detection (WRED) on ingress and egress
- Packet marking (DiffServ)
- Traffic shaping and policing (ingress and egress)
- Packet and byte counter statistics (ingress and egress)

Security

- Wirespeed ACLs
- MD5 password encryption and authentication for routing protocols
- Classification and prioritization of control traffic
- Secure Shell (SSH) v1/v2 and Secure Copy (SCP)
- IEEE 802.1x port-based authentication
- Prevention of unauthorized communication between DSL subscribers
- DHCP-based automatic IP/MAC filter and static Address Resolution Protocol (ARP) cache population for DSL subscribers
- Dedicated management Ethernet routing instance
- Control processor module queuing (CPMQ); separate hardware-based CPM queues allocated on a per-peer basis
- Inbound and outbound LDP label binding filtering
- Limitation of MAC address moves between VPLS instances

Management

- Alcatel-Lucent 5620 SAM provides extensive Fault, Configuration, Accounting, Performance, and Security (FCAPS)
- Fully featured industry CLI, including service CLI
- SSH v1/v2 and Telnet

- FTP, TFTP and SCP
- RADIUS (AAA)
- TACACS+
- SNMP v1, v2c and v3
- Local and remote port/service/flow mirroring
- Service assurance tools, including service ping, SDP ping, LSP ping, MAC ping and MAC traceroute
- Path maximum transmission unit (MTU) size measurement
- Round-trip delay, jitter, loss measurement (SAA)

Safety standards and compliance agency certifications

Safety

- CAN/CSA/C22.2 No. 60950-1-03
- ANSI/UL 60950-1-2002
- IEC 60950: 1999 Third Edition
- EN 60825-1 Safety of Laser Products
- CB Test Certificate

EMC

- EN 300 386 V 1.3.1.2001 - For equipment operating in telecommunications centers
- VCCI Class A
- FCC Part 15 Class A
- EN 55022 Class A
- EN 55024: 1998 - For Information Technology Equipment
- ICES-0003 Class A
- CE Declaration

Certifications

Network Equipment Building System (NEBS)

- SBC-TP-76200
- Telcordia GR-1089-CORE
- Telcordia GR-63-CORE

Environmental

- ETS 300 019-1-1, Storage Tests, Class 1.2
- ETS 300 019-1-2, Transportation Tests, Class 2.3
- ETS 300 019-1-3, Operational Tests, Class 3.2
- ETS 300 019-2-4 pr A1 Seismic
- ETS 300 753 Acoustic Noise

Environmental conditions

- Operating temperature: 0°C to 40°C (32°F to 104°F)
- Relative humidity: 5% to 85% (non-condensing)
- Operating altitude: sea level to 3962.4 m (13,000 ft)

Standards compliance

- IEEE 802.1d Bridging
- IEEE 802.1p/Q VLAN Tagging
- IEEE 802.1s Multiple Spanning Tree
- IEEE 802.1w Rapid Spanning Tree Protocol
- IEEE 802.1x Port Based Network Access Control
- IEEE 802.1ad Provider Bridges
- IEEE 802.1ah Provider Backbone Bridges
- IEEE 802.1ag Service Layer OAM
- IEEE 802.3ah Ethernet in the First Mile
- IEEE 802.1ak Multiple MAC Registration Protocol

- IEEE 802.3 10BaseT
- IEEE 802.3ad Link Aggregation
- IEEE 802.3ae 10Gbps Ethernet
- IEEE 802.3ah Ethernet OAM
- IEEE 802.3u 100BaseTX
- IEEE 802.3x Flow Control
- IEEE 802.3z 1000BaseSX/LX
- IEEE 802.1ad Provider Bridges
- IEEE 802.1ah Provider Backbone Bridges
- IEEE 802.1ag Service Layer OAM
- IEEE 802.3ah Ethernet in the First Mile
- IEEE 802.1ak Multiple Registration Protocol

Protocol support

OSPF

- RFC 1765 OSPF Database Overflow
- RFC 2328 OSPF Version 2
- RFC 2370 Opaque LSA Support
- RFC 2740 OSPF for IPv6 (OSPFv3) draft-ietf-ospf-ospfv3-update-14.txt
- RFC 3101 OSPF NSSA Option
- RFC 3137 OSPF Stub Router Advertisement
- RFC 3623 Graceful OSPF Restart – GR Helper
- RFC 3630 Traffic Engineering (TE) Extensions to OSPF Version 2
- RFC 4203 for Shared Risk Link Group (SRLG) sub-TLV

BGP

- RFC 1397 BGP Default Route Advertisement
- RFC 1772 Application of BGP in the Internet
- RFC 1965 Confederations for BGP
- RFC 1997 BGP Communities Attribute
- RFC 2385 Protection of BGP Sessions via MD5
- RFC 2439 BGP Route Flap Dampening
- RFC 2547bis BGP/MPLS VPNs
- RFC 2796 BGP Route Reflection: Alternative to Full-mesh IBGP (previously RFC 1966) draft-ietf-idr-rfc2796bis-02.txt.
- draft-ietf-idr-rfc2858bis-09.txt.
- RFC 2918 Route Refresh Capability for BGP-4
- RFC 3065 Confederations for BGP draft-ietf-idr-rfc3065bis-05.txt.
- RFC 3392 Capabilities Advertisement with BGP4
- RFC 4271 BGP-4 (previously RFC 1771)
- RFC 4360 BGP Extended Communities Attribute
- RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs) (previously RFC 2547bis BGP/MPLS VPNs)
- RFC 4724 Graceful Restart Mechanism for BGP – GR Helper
- RFC 4760 Multi-protocol Extensions for BGP (previously RFC 2858)

IS-IS

- RFC 1142 OSI IS-IS Intra-domain Routing Protocol (ISO 10589)
- RFC 1195 Use of OSI IS-IS for routing in TCP/IP & dual environments
- RFC 2763 Dynamic Hostname Exchange for IS-IS
- RFC 2966 Domain-wide Prefix Distribution with Two-Level IS-IS
- RFC 2973 IS-IS Mesh Groups

RFC 3373 Three-Way Handshake for Intermediate System to Intermediate System (IS-IS) Point-to-Point Adjacencies

RFC 3567 Intermediate System to Intermediate System (ISIS) Cryptographic Authentication

RFC 3719 Recommendations for Interoperable Networks using IS-IS

RFC 3784 Intermediate System to Intermediate System (IS-IS) Extensions for Traffic Engineering (TE)

RFC 3787 Recommendations for Interoperable IP Networks

RFC 3847 Restart Signaling for IS-IS – GR Helper

RFC 4205 for Shared Risk Link Group (SRLG) TLV
draft-ietf-isis-igp-p2p-over-lan-05.txt

LDP

RFC 3036 LDP Specification

RFC 3037 LDP Applicability

RFC 3478 Graceful Restart Mechanism for LDP – GR Helper
draft-jork-ldp-igp-sync-03

IPv6

RFC 1981 Path MTU Discovery for IPv6

RFC 2375 IPv6 Multicast Address Assignments

RFC 2460 Internet Protocol, Version 6 (IPv6) Specification

RFC 2461 Neighbor Discovery for IPv6

RFC 2462 IPv6 Stateless Address Auto configuration

RFC 2463 Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 Specification

RFC 2464 Transmission of IPv6 Packets over Ethernet Networks

RFC 2529 Transmission of IPv6 over IPv4 Domains without Explicit Tunnels

RFC 2545 Use of BGP-4 Multiprotocol Extension for IPv6 Inter-Domain Routing

RFC 2710 Multicast Listener Discovery (MLD) for IPv6

RFC 2740 OSPF for IPv6

RFC 3306 Unicast-Prefix-based IPv6 Multicast Addresses

RFC 3315 Dynamic Host Configuration Protocol for IPv6

RFC 3587 IPv6 Global Unicast Address Format

RFC 3590 Source Address Selection for the Multicast Listener Discovery (MLD) Protocol

RFC 3810 Multicast Listener Discovery Version 2 (MLDv2) for IPv6

RFC 4007 IPv6 Scoped Address Architecture

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